

Listing of Claims

The following listing of claims will replace all prior versions, and listings, of claims in the present application. Please note that claims 32 and 51 are being amended.

32. (Amended) An apparatus for heat treating semiconductor wafers comprising:
- a thermal processing chamber adapted to contain a semiconductor wafer; and
 - a heating device in communication with said thermal processing chamber for heating a semiconductor wafer in said chamber, said heating device comprising:
 - (a) a plurality of light energy sources configured to emit light energy onto said semiconductor wafer, said light energy sources being positioned so as to form an irradiance distribution across a surface of said semiconductor wafer; and
 - (b) at least one tuning device positioned amongst said light energy sources, said tuning device being configured to emit focused amounts of light energy, said tuning device comprising a light energy source spaced from at least one optical element comprising at least one focusing lens, said optical element being configured to focus and direct light energy being emitted by said light energy source onto said semiconductor wafer at a particular location in a manner for more uniformly heating said semiconductor wafer.

33. An apparatus as defined in claim 32, further comprising a substrate holder for holding said semiconductor wafer, said substrate holder being configured to rotate said wafer.

35. An apparatus as defined in claim 32, wherein said tuning device is mounted in a movable support structure.

36. An apparatus as defined in claim 35, wherein said support structure comprises a tiltable lever arm.

37. An apparatus as defined in claim 32, wherein said light energy source and said at least one focusing lens are mounted on a support structure, said support structure being movable for directing light energy emitted from said light energy source onto a determined location on said semiconductor wafer.

38. An apparatus as defined in claim 37, wherein the said support structure comprises a tiltable lever arm.

39. An apparatus as defined in claim 32, further comprising:
at least one temperature sensing device for sensing the temperature of said semiconductor wafer at least one location; and
a controller in communication with said at least one temperature sensing device and at least one of said light energy sources, said controller being configured to control the amount of light energy being emitted by said light energy sources in response to temperature information received from said at least one temperature sensing device.

40. An apparatus as defined in claim 32, wherein said apparatus contains at least three of said tuning devices.

41. An apparatus as defined in claim 39, wherein said controller is configured to control the amount of light energy being emitted by said tuning device independently of said plurality of light energy sources.

42. An apparatus as defined in claim 32, wherein said plurality of light energy sources are horizontally oriented with respect to said semiconductor wafer.

43. An apparatus for heat treating semiconductor wafers comprising:
a thermal processing chamber adapted to contain a semiconductor wafer; and

a heating device in communication with said thermal processing chamber for heating a semiconductor wafer in said chamber, said heating device comprising:

(a) a plurality of light energy sources configured to emit light energy into said semiconductor wafer, said light energy sources being positioned so as to form an irradiance distribution across a surface of said wafer; and

(b) at least one tuning device comprising a laser diode, said laser diode emitting light energy onto a determined location on said semiconductor wafer in order to more uniformly heat said semiconductor wafer.

44. An apparatus as defined in claim 43, further comprising a substrate holder for holding said semiconductor wafer, said substrate holder being configured to rotate said wafer.

45. An apparatus as defined in claim 43, wherein said tuning device is mounted in a movable support structure.

46. An apparatus as defined in claim 43, wherein said tuning device is adjustable for directing light energy being emitted from said at least one laser diode onto a determined location on said semiconductor wafer in order to more uniformly heat said semiconductor wafer.

47. An apparatus as defined in claim 43, further comprising:

at least one temperature sensing device for sensing the temperature of said semiconductor wafer at least one location; and

a controller in communication with said temperature sensing device with at least certain of said light energy sources, and with said tuning device, said controller being configured to control the amount of light energy being emitted by said light energy sources and said tuning device in response to temperature information received from said temperature sensing device.

48. An apparatus as defined in claim 47, wherein said controller is configured to control the amount of light energy being emitted by said at least one tuning device independently of said light energy sources.

49. An apparatus as defined in claim 43, wherein said apparatus contains at least three of said tuning devices.

50. An apparatus as defined in claim 43, wherein said plurality of light energy sources are horizontally oriented with respect to said semiconductor wafer.

51. (Amended) An apparatus for heat treating semiconductor wafers comprising:
a thermal processing chamber adapted to contain a semiconductor wafer; and
a heating device in communication with said thermal processing chamber for heating a semiconductor wafer contained in said chamber, said heating device comprising:
(a) a plurality of light energy sources configured to emit light energy onto said semiconductor wafer, said light energy sources being positioned so as to form an irradiance distribution across a surface of said wafer, the light energy sources being horizontally oriented with respect to the semiconductor wafer, each of said light energy sources comprising a first lamp device; and

(b) at least one tuning device positioned amongst said light energy sources, said tuning device being generally vertically oriented with respect to the semiconductor wafer and comprising a second lamp device, wherein said first lamp device is different from said second lamp device, the tuning device emitting localized and focused light energy in a manner for more uniformly heating the semiconductor wafer.

52. An apparatus as defined in claim 51, further comprising a substrate holder for holding said semiconductor wafer, said substrate holder being configured to rotate said wafer.

53. An apparatus as defined in claim 51, wherein said tuning device is mounted in a movable support structure.

54. An apparatus as defined in claim 51, further comprising:
at least one temperature sensing device for sensing the temperature of said semiconductor wafer at least one location; and

a controller in communication with said temperature sensing device with at least certain of said light energy sources, and with said tuning device, said controller being configured to control the amount of light energy being emitted by said light energy sources and said tuning device in response to temperature information received from said temperature sensing device.

55. An apparatus as defined in claim 54, wherein said controller is configured to control the amount of light energy being emitted by said at least one tuning device independently of said light energy sources.

56. An apparatus as defined in claim 51, wherein said apparatus contains at least three of said tuning devices.

58. An apparatus as defined in claim 51, wherein said tuning device comprises a laser diode.

59. An apparatus as defined in claim 58, wherein said plurality of light energy sources comprises tungsten halogen lamps.

60. An apparatus for heat treating semiconductor wafers comprising:
a thermal processing chamber adapted to contain a semiconductor wafer; and
a heating device in communication with said thermal processing chamber for heating a semiconductor wafer in said chamber, said heating device comprising:

(a) a plurality of light energy sources configured to emit light energy onto said semiconductor wafer, said light energy sources being positioned so as to form an irradiance distribution across a surface of said semiconductor wafer; and

(b) at least one tuning device comprising a prismatic surface, said tuning device positioned amongst said light energy sources, said tuning device being configured to direct light energy being emitted by said light energy sources onto said semiconductor wafer in a manner for more uniformly heating said semiconductor wafer.

61. An apparatus as defined in claim 60, further comprising a substrate holder for holding said semiconductor wafer, said substrate holder being configured to rotate said wafer.

62. An apparatus as defined in claim 60, wherein said tuning device is mounted in a movable support structure.

63. An apparatus as defined in claim 62, wherein said support structure comprises a tiltable lever arm.

64. An apparatus as defined in claim 60, wherein said prismatic surface has a fixed pitch and a fixed facet angle.

65. An apparatus as defined in claim 60, wherein said prismatic surface has a fixed pitch with a variable facet angle.

66. An apparatus as defined in claim 60, wherein the height of said optical element is adjustable with respect to said light energy sources.

67. An apparatus as defined in claim 60, wherein said apparatus contains at least three of said tuning devices.

68. An apparatus as defined in claim 60, further comprising:

at least one temperature sensing device for sensing the temperature of said semiconductor wafer at at least one location; and

a controller in communication with said at least one temperature sensing device and at least one of said light energy sources, said controller being configured to control the amount of light energy being emitted by said light energy sources in response to temperature information received from said at least one temperature sensing device.

69. An apparatus as defined in claim 60, wherein said prismatic surface comprises a ruled prismatic surface.

70. An apparatus as defined in claim 60, wherein said tuning device reflects light energy being emitted by said light energy sources.

71. An apparatus as defined in claim 60, wherein said tuning device refracts light energy being emitted by said light energy sources.

72. An apparatus as defined in claim 60, wherein said prismatic surface is made from a highly reflective material having a reflectivity of at least 0.9 at a wavelength being emitted by said light energy sources.

73. An apparatus as defined in claim 60, wherein said prismatic surface comprises a diffuse surface for reflecting and scattering light energy.